ION2G+™ Selective Calling

V0.9

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GLOSSARY

ALE .....Automatic Link Establishment. Both the name for the specific protocol and for the general function.

AMD .....Automatic Message Display. It is a way to send a message to appear on the display of a radio running ALE.

AQC .....Alternate Quick Call. AQC is an improved version of ALE that works more reliably and more rapidly than the original ALE protocol.

BER .....Bit Error Rate. This is how often errors occur in a data stream. A BER of zero is perfect, i.e., no errors. Lower values are better.

CCIR-493-4.....The UN specification for selcall.

DBM .....Data Block Mode. A mode for transferring arbitrary binary data using the digital signaling mode of ALE.

DTM .....Data Text Mode. Like DBM but specifically for text.

code plug .....A file containing a list of commands to configure ION2G. Most complex radios that support ALE use some form of code plug file although the code plug from one radio is probably not usable on a different brand of radio.

LQA.....Link Quality Analysis. ALE determines the “goodness” of a path from another station by measuring BER and SINAD for all the different channels. This is used to build an LQA database that is used to determine the best channel for communications between two stations.

Mil Std 188-141.....The US Military Standard defining ALE and AQC. The 141 is always followed by a letter denoting the version of the document. The current version is 188-141D.

PTT .....Push-to-talk. This is the signal used to make the radio switch from receive to transmit.

RSSI .....Receive Signal Strength Indicator

Score .....A measurement of general LQA “goodness”, generated from both BER and SINAD. The value typically ranges from 0-99. Each manufacturer calculates this differently. Regardless, the “score” is how an ALE radio determines the best channel to use.

selcall.....Selective Calling. Selcall is the precursor protocol to ALE. The current standard is CCIR-493-4.

self address .....The address assigned to a station to which it responds when called and uses when placing a call. Stations may have more than one self address per network but of those, one is primary and is used to identify the station when placing a call or a sounding.

sounding .....A periodic transmission made by an ALE station on all channels, intended to be received by all other stations for the purpose of performing LQA. It is an, “I am here,” message.

SINAD .....The ratio of signal+noise+distortion to noise+distortion, usually expressed in decibels. Sometimes call signal-to-noise ratio. The higher this ratio, the better the signal quality and readability. Higher values are better.

TFD/T2FD .....Terminated Folded Dipole or Terminated Tilted Folded Dipole — a broadband antenna type commonly used with ALE.

INTRODUCTION

Welcome to ION2G, a full-featured implementation of CCIR-493-4 Selective Calling (selcall) and Mil-Std 188-141D Automatic Link Establishment (ALE). Every attempt is being made to make ION2G fully interoperable with existing selcall and ALE systems from other vendors. Where ION2G offers additional features, those features are either part of the existing specification or made to be as close to the existing specification as possible. The goal is full interoperability with systems from other manufacturers.

ION2G is software. The hardware requirements are broad. ION2G runs on Windows 10, MacOS, Debian Linux, and Raspberry Pi, allowing the use of ION2G on almost all popular computing platforms. For dedicated radio service a laptop computer or the Raspberry Pi offer an inexpensive way to add selcall and ALE to nearly any HF transceiver.

Selective Calling operation is very simple. Stations are assigned either a 4-digit or 6-digit address. When Alice wishes to call Betty, Alice selects a channel and issues a call to Betty's selcall address. Betty's station is scanning the available selcall channels and stops scanning when it picks up Alice's call. Betty's radio then alerts Betty of the incoming call. Alice and Betty then carry on a conversation over their radios.

The limitation of selcall is that Alice needs to have some idea of which channel will be best to call Betty. Since radio propagation varies depending on time of day, time of year, and sunspots, the best channel is constantly changing. This requires Alice to be aware of propagation changes and to guess at the best channel. If worse comes to worse, Alice may have to keep calling Betty on different channels until one connects or Alice gives up in frustration.

Enter ALE.

ALE is a significant improvement on selcall in that it attempts to automatically determine the best channel for communications. It does this by listening to transmissions from other stations while measuring the quality of the signal for errors (bit error rate - BER) and signal-to-noise ratio (SINAD).

In order to assist in this process stations periodically transmit an, "I am here," message called a 'sounding'. Soundings are transmitted on all channels so other stations that are listening can determine the best channel based on lowest BER and highest SINAD for each station they hear. The receiving station then performs Link Quality Analysis (LQA) on every signal on every channel and builds an LQA database based on time, frequency, recent sounding data, and historic sounding data. This allows the ALE radio to make a reliable best-guess at the best channel for communications.

Now when Alice calls Betty, Alice does not need to guess and select a channel. Alice's radio will make the channel decision for Alice based on information in the LQA database, trying each channel in the order of that channel's 'score'. Users of the radio no longer need special radio knowledge or radio operation skills. With ALE, operation on HF becomes more like using a telephone than using a radio.

Each ALE station must be programmed with several pieces of information in order to participate in an ALE network. First, the station must be programmed to know that an ALE network exists, the station's own 'self-address', what channels are to be scanned, and what operating mode is used. There are two 'flavors' of second-generation (2G) ALE being used: Automatic Link Establishment (ALE) and Alternate Quick Call (AQC). Of the two, AQC performs better but for some reason very few radios implement AQC. ION2G supports both and may use them interchangeably.

If the network is intended to support both ALE and AQC then two networks must be defined using the same set of channels. When the operator makes a call to another station, the operator then chooses the correct network which determines the mode of the call.

SOFTWARE INSTALLATION

ION2G runs on several hardware platforms: Windows 10 and Raspberry Pi. Installation differs for the different platforms.

WINDOWS 10

1. Download the windows distribution from http://ion2g.app. This will be a zip archive file.

2. Allow the browser to open the archive file in Windows Explorer.

3. Select a convenient location for the new ION2G folder to be located, e.g., desktop.

4. Select ‘Extract All’ from the Windows Explorer menu bar.

5. When the extraction is complete, double click on the new folder.

6. Scroll down to ion2g.exe and double click on that.

7. ION2G is now running.

RASPBERRY PI

8. Install Raspbian on a Raspberry Pi 4. Use the stripped down version with the desktop.

9. Using a browser on the Pi, download the ION2G package from http://ion2g.app. The browser will probably download the file to the Downloads folder. Using the File manager, move the downloaded file to where you plan to use it. If you aren’t sure, drag it to the desktop.

10. Right click on the downloaded file. Select ‘Extract Here’ to create the ION2G folder with the program inside.

11. Once the file has been extracted to the desktop and the folder appears, double-click on the folder.

12. When the folder opens in the File Manager, you will see a file ‘ion2g’. Double-click on that file and then click on ‘Execute in Terminal’.

13. ION2G is now running.

CONFIGURATION

Setting up an ALE radio, any ALE radio, is non-trivial. There are a lot of things you must get correct. Here is a general list of things you must do and the approximate order you must do them. These are all in the settings section of ION2G:

1. Fill in the "Operator" section. This is not critical but is a useful place to have that information stored. In the future more will be done with that information. (In other words, you can skip this part and ION2G will still work properly.)

2. If you have a code plug you want to use, go into the 'Code Plugs' section and use either 'Load From File' or 'Load From Web' to load the code plug. Right now due to the changing nature of ION2G, the 'Load From Web' option might not get you a fully running code plug. If you choose this option you should still manually inspect all the configuration options to be sure everything is set properly. (I will talk about 'Save Code Plug' later.

3. Next set the audio input and output devices. This determines how the baseband audio gets from the receiver to ION2G and from ION2G to the transmitter, how alert signals are handled, and mic/headset audio is handled.

    3.1. If your radio has a single USB connection for both the sound card and the rig control then you are going to specify that device. That normally shows up as 'USB Audio CODEC' for Icom radios. If the rig is connected via speaker/mic or line-level inputs to your interface or sound-card, you will use the name of your sound card input/output here.

    3.2. In most cases you would set ‘Input Level’ and ‘Output Level’ to 100%. If ION2G is overdriving the radio on transmit (ALC and/or output power too high) adjust ‘Output Level’ downward until ALC/PO is normal.

    3.3. If you click on 'Radio' at the bottom of the main window, and then click on 'SPECTROGRAM', the waterfall window will open. If you begin to see the blue waterfall, you have properly selected the audio input device.

    3.4. Scroll down to ‘Operator Interface Audio’. This is where you set how ION2G communicates with you. Enable this to hear alert tones and to activate the mic input.

    3.5. Set ‘Output Device’ to the audio device that sends audio to the computer’s speakers.

    3.6. Enable ‘Channel Audio’ to hear the received signal from the computer’s speakers. If you prefer to listen through the radio’s speaker, leave this box unchecked.

3.7. Select which type of sound ION2G should make for each type of call received. You can verify that alert audio is working correctly by clicking the ‘Play’ button for a sound.

4. Click on 'Settings' and then 'Radio Controls'. The three primary things that must be selected here are:

4.1. 'Radio' is the type of radio you have so that ION2G may send the correct commands. Different radios have different configuration requirements. If the radio driver requires additional information, additional configuration boxes will appear. For example, Icom uses a communications protocol called CI-V. Because different radios may be connected to the same CI-V bus, each radio has a unique address. Normally the default value is acceptable but if you have more than one of the same type of radio on the CI-V bus, you will need to assign them different addresses and then tell ION2G which one to use to communicated with which radio.

4.2. 'Serial Port' is which serial port on the computer ION2G will use to send commands to the radio and get status from the radio.

4.3. 'Baud Rate' is the speed at which commands are sent to the radio. This MUST match the radio's internal settings or no communication will take place. Some radios have a fixed speed which you can look up in the manual. Some radios have an adjustment for this. Regardless, the baud rate set into ION2G and the baud rate of the radio must be the same.

4.4. 'Data Bits' is usually set to '8' unless otherwise indicated in the radio's owners manual.

4.5. 'Parity' is almost always 'NONE' unless otherwise indicated in the radio's owners manual.

4.6. 'Stop Bits' is almost always 'One' but setting it to 'Two' is safe. It just slows data transmission a little.

4.7. The settings of RTS/CTS and DTR are very radio and/or interface dependent. Newer radios do not need flow control so none of these boxes will be checked. If you are using a sound-card interface to your radio you will need to get guidance from the manual for the interface as to what is needs to operate correctly. Usually RTS or DTR are used to key the transmitter in the case of of a separate sound-card interface. More on this next.

4.8. 'PTT Method' is how ION2G will switch the radio from RX to TX and back again. The two most common ways are 'CAT' and 'RTS'. If you have a single USB cable connecting your radio to the computer running ION2G then the 'CAT' setting is likely correct. That means ION2G will send 'transmitter on' and 'transmitter off' commands to the radio over the radio control channel. If your radio is using a sound-card interface box, that setting is most likely to be 'RTS' but may be 'DTR'.

Again, the manual for your interface will guide you in setting this.

The 'VOX' setting is a last-resort setting. It depends on ION2G starting the transmit audio and the VOX function of the transceiver keying the radio. It can work but it is less reliable than the other methods.

4.9. Once you have all the parameters set properly go back to the top and click on ‘Save and Test’. ION2G will report on whether or not it established communications with the radio and will issue a command to transmit. The radio should go into transmit mode and produce full output. Take this time to check the ALC and power output of the radio, adjusting the transmit level value in the audio window to achieve nearly full output with minimal ALC.

5. Back out of 'Radio Controls' (use '<Settings' in the upper left) and then click on 'Channels'. Here you will define each of your channels. Each channel must have a name, a frequency, a mode, and how it may be used. To define a new channel, click on the '+' in the upper right.

Please note: for initial setup, loading a pre-configured code plug is the easiest way to get your channels correctly configured for your ALE networks. For radio amateurs, code plugs may be obtained from https://ion2g.app. For other services, please contact your ALE network manager.

5.1. 'Channel Name' and 'Frequency' are self-explanatory. Frequency is in Kilohertz (kHz).

5.2. 'Mode:' is almost always 'USB' for upper-sideband. ALE follows the commercial standard and uses USB on all frequencies unlike ham voice channels which use LSB below 10MHz. (Except for 60m.)

5.3. 'Enable Scanning' is checked for any channel that will be used for ALE.

5.4. 'Enable Transmit' is checked for any channel that will be used for ALE.

5.5. 'Traffic Channel' is a special case for a channel which may be used for a QSO but is not a normal part of the ALE network. ION2G has the ability to call on one channel and then switch automatically to a "traffic channel", thus freeing up the calling/sounding frequency. Traffic channels that have this box checked might not have the 'Enable Scanning' box checked. They definitely will have the 'Enable Transmit' box checked.

5.6. Be sure to click 'OK' to confirm your work and create the channel.

5.7. Repeat the above for each channel you need to create. Once all the channels are entered, go back to the settings menu (‘<Settings').

6. Now you must create the ALE network(s). Each ALE network includes a network name and a number of channels that make up that network, how rapidly the channels should

be scanned (dwell time), and how long between soundings. Knowing what networks to create and how depends on knowing the characteristics of that network which must be acquired from the network manager. In many cases the network manager can and will provide a code plug containing the channel and network definitions.

If you are starting from scratch, here is how you define a network.

6.1. Select 'Networks' and then use the '+' to create a network.

6.2. Fill in Network Name. For ham use this will probably be either ‘HFN’ or ‘HFL’.

6.3. If sounding is allowed, click the check-box. For some networks, e.g. HFL, you will want to scan but not sound to leave this box unchecked. In the case of two networks using the same bands, link quality analysis (LQA) data from one network, e.g. HNN, will be used for determining best channel for the parallel network, e.g. HFL.

If sounding is allowed you will need to set the ‘Sounding Interval’, i.e., how many minutes between soundings. The usual values range from 60-240 minutes (1-4 hours). The network manager should give you this value.

6.4. Is this network allowed to scan? The answer is almost always yes so this box should be checked. Dwell time is how long the receiver should stop on each channel to listen for calls. If the scan rate is 2 channels per second, dwell time should be set to 500ms (½ second). If the scan rate is 5 channels per second, dwell time should be set to 200ms (1/5 second).

6.5. The ‘Calling Cycle Length’ sets the amount of time the station will call to ensure that it “captures” all the receivers. If there are 10 channels and the scan rate is 5 channels/second one would expect it to take 2 seconds to complete the scan cycle. However, some receivers will dwell longer on a channel if they think they detect a signal, thus slowing the scanning. Setting the Calling Cycle Length longer will ensure that a station calls long enough to be sure that all the receivers manage to scan to that channel and hear the call. HFN and HFL typically use 15 seconds. SHARES uses 10 seconds.

6.6. ‘Activity Reporting’ is for the station to report what it hears back to either the HFLINK or SHARES activity map servers. If you have a base station with full-time Internet connectivity, you will probably want to enable this for your network.

6.7. ‘Filter addresses < 4’ is used with reporting and the internal LQA database to prevent partially-decoded addresses from being stored and reported as a new station. Since ALE breaks everything into groups of 3 letters it is possible for the call WB6RQN to be decoded as WB6. Since we know that in both ham and SHARES that IDs will be callsigns and callsigns are guaranteed to be longer than 3 characters, setting this option will prevent partially-decoded IDs from be interpreted as full IDs.

6.8. Now you must add the channels to the network. For each channel you will click ‘Add’ and then select from the list of channels previously defined. Repeat this until all the channels are added to the network.

6.9. Lastly, click on the ‘Save’ button to make the added network and its configuration permanent.

7. Ignore ‘Band Groups’. This will probably be removed in future versions.

8. Now select the ALE option. This sets the general settings for ALE and AQC operation.

8.1. Most of the settings in this section should be left alone. The default values are probably correct for most cases. Change these only if you know what they do. If different settings are required the manager for the network will tell you or provide you with new values.

8.2. Skip down to the ‘Enable Sounding’ checkbox and check it. If sounding is allowed on ANY of your networks, this box must be checked or your station will not be allowed to send soundings.

8.3. Leave ‘LQA Decay’ and ‘LQA Window’ set to 7 days and 2 hours respectively.

8.4. For most networks you will want the options ‘Enable LQA Exchange’, ‘Enable Anycall’, and ‘Enable Allcall’ to be checked. ‘Sound on Hangup’ probably should not be checked unless you know that your will stay linked for a long period of time.

8.5. Leave the ‘AQC Specific Settings’ alone unless directed to change them by the network manager.

9. ‘ALE Nets’ is used to create groups of stations within a network. Normally you would not use this feature unless you fully understand how ALE creates small groups. Generally speaking, this has very specific uses in small networks. This is a little-used feature.

10. ‘ALE Self Address’ is extremely important and you will need to enter your Self Address(es) for each ALE network you are on. If you have three networks defined, e.g., HFN, HFL, and NCS ALE, you would have at least 3 self-address entries. Normally your self-address will be your callsign, e.g., WB5BL, NNA6BL, etc. Some networks reverse the first and second half of the address, e.g., WB6RQN would become RQNWB6. If you are not sure, you may enter more than one self-address per network. Just be sure to designate one address per network as primary by checking the ‘Primary’ box as that will we used as your self-address when transmitting.

11. ‘CCIR-493-4’ is used for setting up the older selective calling (“selcall”) system. In many ways “selcall” makes more sense for ham radio operation than does ALE. It is not as automated but works very well for an “open” network where people can add themselves to a network and the network is not centrally managed.

12. The ‘Other’ section is used as a catch-all for many things that don’t have another section they logically belong with. There are some things that must be set here anyway so be sure to examine this section.

    12.1. ‘Call Monitor Time’ sets how long a station will listen to a call before determining that the call does not apply to that station. The best setting is ‘0’ indicating that the station should wait all the way through the call before continuing to scan.

    12.2. ‘Enable Listen Before Transmit’ and ‘Listen Before Transmit Time’ are used to enable the LBT function. If a channel is used by more than one network or people use the ALE channel for voice operations, turning on LBT is probably a good thing to do. Most operators do not appreciate having their QSO interrupted by an automatic system. This should probably be enabled and set for 1 second when operating on the ham bands. For SHARES, disable LBT.

    12.3. ‘TX Tune Preamble’ is used when the station has an automatic antenna tuner. It determines how much extra transmit time should be added to the front of the transmission to allow the tuner time to tune the antenna. If using a broadband antenna that requires no tuning, e.g., TFD, T2FD, BBTD, LPDA, etc., then set this value to zero.

    12.4. ‘VOX/Delay Preamble’ is used when you are using VOX to key the transmitter. In order not to lose the first part of a transmission, this value is set to the amount of time it takes for VOX to key the transmitter. For most radios VOX takes 50ms-200ms to key the radio. If you are not using VOX, set this to 0.

    12.5. ‘TX Audio Delay’ is for any extra delay needed after asserting PTT before ION2G sends audio to the radio. Normally this can be left at 0.

    12.6. ‘Activity Reporting’ is very network specific. For HFLINK enable this and set ‘HFLINK Report Call Sign’ to your ham call. If on SHARES, enable this, enter the URL of the SHARES server, and enter the ‘SHARES Report Key’ you have been assigned. If you do not have a key, contact the SHARES ALE network manager to acquire one. The key takes the form of

    12.7. ‘Call History’, ‘Message History’, ‘Log Buffer Length’, ‘ALE Sounding Popup Dialog’, and ‘Dark Mode’ are all personal preference items. Set them to what you like best.

13. The ‘Emergency’ section is for setting the selcall ID for emergency calls. ALE would use either Allcall or Anycall for this purpose.

14. The last section is ‘License’. You would select your ION2G license file if you have chosen to run a licensed version. A license is required for anyone not a ham running ION2G on the ham bands.

    Currently ION2G is free to individual SHARES users. Governmental agencies and NGOs must negotiate a purchase agreement.

DIRECTORY

After the station is configured using the ‘Settings’ section, you will probably want to add directory entries (Contacts) for each person you might want to call on the ALE or selcall network(s). Clicking at the bottom of the main window on the ‘Directory’ icon will open the directory for editing or use. To add an entry to the directory, click the ‘Add’ button in the upper left and fill in the fields. You will need to add their address on each network where that person can be reached.

There are two specials addresses that may be used: ALLCALL and ANYCALL. ALLCALL is like a QST message. It instructs ALL stations hearing the ALLCALL to stop scanning and open their squelch. This would be used for something like starting a net. Since it is addressing all stations there is no way for ALE to know which is the best channel to use so when attempting to do an ALLCALL the operator must manually select a channel. There is no response to an ALLCALL as the receiving station just stop, listen, and notify their operators that an ALLCALL was received. If the operator does not accept the ALLCALL then the radio goes back to scanning after some period of time.

ANYCALL is like calling CQ. It means you want to go into linking mode with any station that can hear you. Stations hearing your ANYCALL will respond to you.

Use of ALLCALL and ANYCALL should be limited to nets and emergency communications.

So, to create a directory entry for making ALLCALL or ANYCALL, use the keywords ‘ALLCALL’ or ‘ANYCALL’ for the station’s name, and then add in the networks.

CODE PLUGS

Once you have configured ION2G it is a very good idea to save your configuration in a code plug. In Settings>Code Plugs you have the option to write out your configuration to a single file using the ‘Save All Single’ button. This is certainly the easiest way to save your whole configuration. If you will be sharing your configuration with others, you have the option to save your code plug in three pieces: Directory, Station, and System.

The Directory section saves all the contact information into one file without saving all the other information about the station configuration. This is extremely useful if you want to share your directory/contact information with other users.

The ‘Station’ code plug file contains only your station-specific information, such as your self-addresses, license key, antenna tuner settings, etc, that would be specific to your radio and station. These are things you don’t want to give someone else when they are setting up their own station.

The ‘System’ code plug contains all the general configuration that would allows someone else to set up their own copy of ION2G to be 100% compatible with you. This code plug contains the channels, networks, ALE general settings, etc.

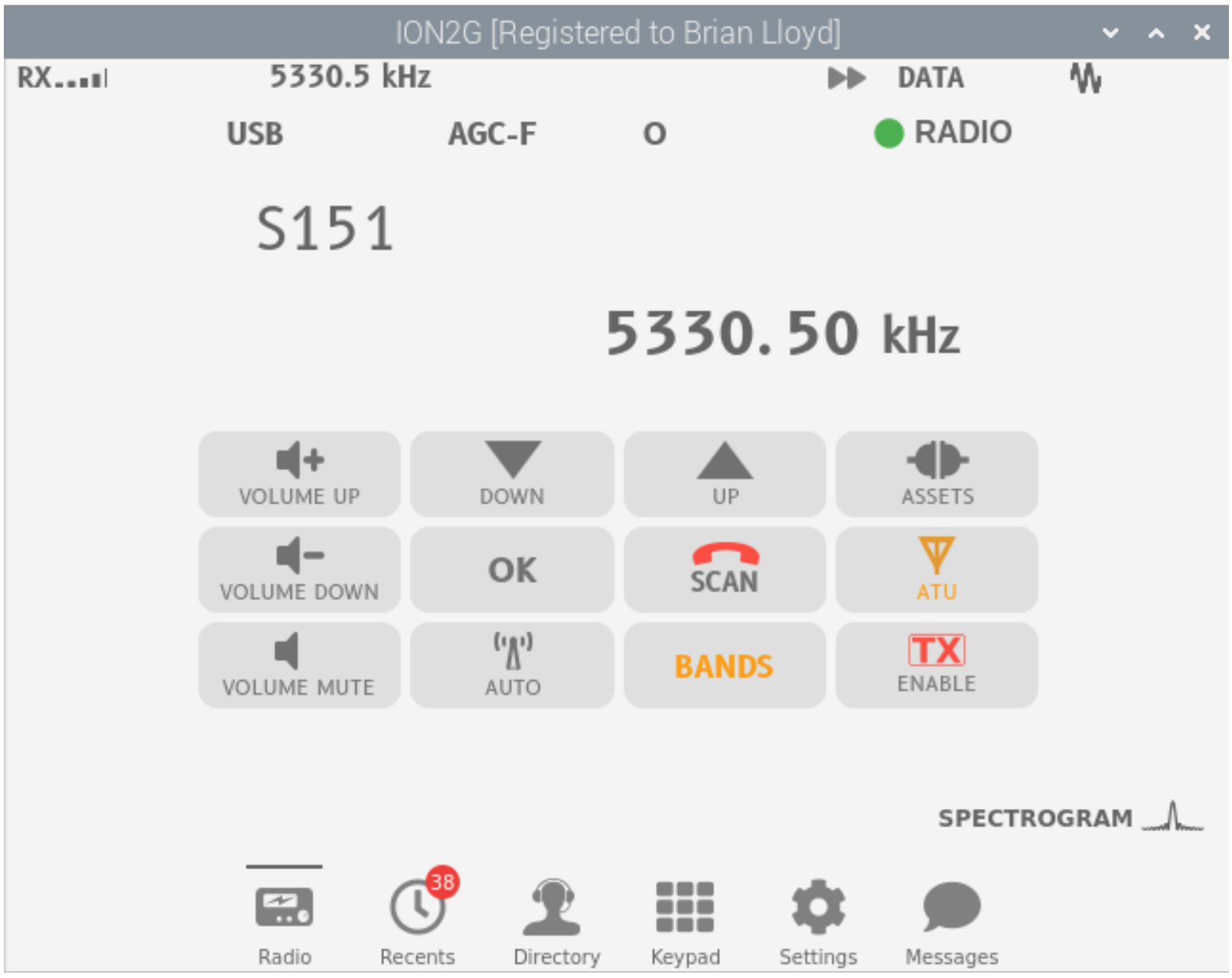
If you want to help someone replicate your configuration, save the Directory and System code plugs, and then send those files to the other person to read in as their code plug.

Organizations can periodically send out Directory updates and/or network updates using this system without otherwise mangling a station’s configuration.

One nice thing about this feature is that it provides a means of combining smaller code plugs into a larger code plug. For instance, a station may have a code plug for SHARES, a code plug for MARS, and a code plug for HFN/HFL. By loading these sequentially one can end up with a configuration that is the union of all three.

OPERATION

Now that ION2G is installed, configured, and running, you will want to use it for communications. When ION2G starts up it will be displaying the main window. This may be identified by the buttons along the bottom labeled Radio, Recents, Directory, Keypad, Settings, and Messages. Here is the main window in Radio mode:



This window has three parts: the header with a number of options; the footer with the Radio, Recents, Directory, Keypad, Settings, and Messages mode selection buttons; and the central section which changes depending on which mode has been selected. The mode is indicated by a bar over the currently selected mode.

HEADER SECTION

The header section has two rows. Across the top is the current RSSI value, the frequency or the words ‘scanning’ or ‘sounding’, a block or double-triangle to toggle the scanning mode on and off, a toggle between data and voice mode, and a double sine-wave to invoke the CW ID function.

The second row contains the radio mode toggle to select upper-sideband (USB) or lower-sideband (LSB), the AGC mode selector, the squelch toggle, and finally the radio communication status indicating whether ION2G is properly communicating with the radio (green dot).

Most of the values are automatically set by the channel data and will not require the operator to change them unless scanning is off and the operator wishes to manually enter a frequency and mode.

The one item that the operator is likely to use on a regular basis is the scanning on/off (block or double-triangle) button. When using ION2G for normal ALE operation the operator probably wants the radio scanning and listening for calls and soundings.

FOOTER SECTION

The footer section is very simple. Clicking on one of the buttons on the bottom selects what will be displayed in the central section. The two exceptions are the Spectrogram and Messages buttons. Each of these opens a new window adjacent to the main window.

CENTRAL BODY

There are a number of buttons in the central body of the Radio window that provide additional control for the radio under ION2G.

On the left side you have the volume and mute buttons. Normally the squelch is open when the radio is not scanning and muted when scanning. This lets you open/mute the audio and set the audio level.

To the right of the Volume Up button are the Down/Up arrows. These are used primarily for tuning the radio. When used by themselves, these step through the stored channels. If you stop the scanning and click on the frequency display, these let you increase/decrease the selected digit in the frequency for manually tuning the radio.

To the right of the Up button the the ASSETS button. This is used when using ION2G to start a link for some other application such as Winlink or fldigi. Once ION2G has established the link, pressing this button releases the audio CODEC and radio control channels to the other program while leaving ION2G in the link-established state. When you want to return control of the radio back to ION2G, click this button again.

QUICK MENU (CONTROL-K)

Pressing control-K (^K) brings up a quick menu for the most used functions, i.e.:

- start scan
- check propagation

- call
- [send] message
- set UI dark mode

For the most-used functions this is faster than navigating the menus.

There is one function in the ^K menu that is not reachable any other way and that is the ‘check propagation’ function. ‘Check propagation’ lets you look at the LQA database for a particular station to see which bands are usable which parts of the day, based on soundings heard over the course of a week. More recent sounding data has more weight than older data. Old data times-out after a week and is discarded.